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FINAL REPORT

TO THE

U.S. CENTENNIAL COMMISSION

ON THE STRUCTURES ERECTED FOR THE

VIENNA UNIVERSAL EXHIBITION, 1873

AND PREVIOUS

EXHIBITIONS IN LONDON AND PARIS.

BY

HENRY PETTIT,

CIVIL ENGINEER,

*Special Agent United States Centennial Commission.*

PHILADELPHIA:

September, 1873.





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McLAUGHLIN BROTHERS,  
PRINTERS,  
112 and 114 South Third Street,  
*Philadelphia.*

*Philadelphia, August 11th, 1873.*

*Hon. D. J. MORRELL,*

*Chairman Executive Committee United States Centennial Commission,*

*Dear Sir:*

*I have the honor to present to you my Final Report on the Structures used for the Vienna Universal Exhibition of 1873. I have also arranged for reference, a short statement giving valuable data concerning the most important of previous English and French Exhibitions. Taking these in connection with my special reports, dated Vienna, April 4th to May 26th, inclusive, I trust you will find some information that may be of use to your Committee.*

*I am, with great respect,*

*Your obedient servant,*

*HENRY PETTIT,*

*Special Agent U. S. C. C.*



# REPORT.

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An International Exhibition, such as that now in operation at Vienna, may be said to resemble in its operation a series of smaller exhibitions for specific purposes, following each other in rapid succession for a period of say six months, during which time an immense central exhibit of the products of all nations is also being held in an Industrial Palace, a Machinery Hall, and numerous annexed buildings. It will at once be obvious, from this fact, that almost every conceivable interest may be brought into connection, and be made to take part in the ultimate success of a Universal Exhibition; and it is also self-evident that in order to insure ultimate success the various departments must be placed under the control of those who are fitted for the work, either by natural ability or previous experience.

Every important Universal Exhibition thus far given by the leading nations of Europe, it will be found, has proven itself, in the end, to be of greater magnitude than its predecessor, and each General Management of previous large Exhibitions has endeavored to prepare itself for the great work by carefully examining all that has been done before. The United States Centennial Commission commenced its work with precisely this same intention on the part of the Executive Committee, and as they have more information and greater resources than any previous body in a similar position, it is most natural to expect that the Philadelphia Exhibition, on the occasion of the Centennial, will be as satisfactory as any that has thus far been held.

If we have understood our mission to Europe aright, its object has been to assist the Executive Committee in obtaining useful information with regard to the technical questions involved in the engineering and architectural features of previous exhibitions, especially Vienna, 1873; and we would respectfully call attention to what will be at once acknowledged in this connection, viz.: that the *most* valuable and interesting portion of such information will *not* be found on the body of this report, but in the engineering and architectural works, translations, papers, drawings, photographs, lithographs, and other illustrations accompanying it.

For the purpose of giving some faint conception of what has been done in Europe with regard to exhibitions, the following partial list of the most remarkable will be of use. The first Industrial Exhibition was held in France in 1798. The first International Industrial Exhibition was the one in Hyde Park, London, in 1851. France, at various places, in 1798, 1801, 1802, 1806, 1819, 1823, 1827, 1834, 1839, 1844, 1849, 1855, 1867. Belgium, at Ghent, 1820. Prussia, at Berlin, 1844. Austria, at Vienna, 1846, 1873. England, at London, 1851, 1862, since become annual, Birmingham, 1849, and at numerous provincial cities. Bavaria, at Munich, 1854. Holland, at Amsterdam, 1859. Ireland, at Dublin, 1829, triennial; 1865, Winter Garden. Russia, at Moscow, 1872.

It is satisfactory to observe, however, that nearly all the essentially good points worthy of study, concerning the buildings used on the above

mentioned occasions, will be found embodied or suggested by the constructions used for the three largest and most successful, viz.: London, 1851, Paris, 1867, and Vienna, 1873, at the same time not omitting to examine London, 1862, and Paris, 1855. The Sydenham Palace may be considered as a second edition of the original 1851 Palace, "*enlarged and revised*," and the Alexandra Palace, Muswell Hill, as ditto of the Exhibition Building of 1862. Each of the three most successful exhibitions above mentioned, had buildings and arrangements radically different from each other, both as to general plan and details of construction, as to external appearance and internal working. Each exhibition was planned in a manner considered by the management at the time to be the best suited to the site and requirements of the occasion, and each accomplished in a greater or less degree what was desired.

We have arranged for reference some general data with regard to each of these five exhibitions, more particularly for the purpose of showing their relative sizes, and the cost of the several constructions.

#### LONDON, 1851.

The first private meeting held on the subject of this Exhibition was at Buckingham Palace, on June 30th, 1849, and the Exhibition was opened to the public on May 1st, 1851. The intermediate period being one year and ten months. It is interesting to observe from some contract drawings accompanying this report, that the actual work upon the buildings proper must have been done between July 1st, 1850, and May 1st, 1851—ten months. (Query, How much can the United States do, twenty-three years later, for her first great exhibition, in two years?) The site for the building in Hyde Park was a rectangular strip of ground containing about 26 acres, and approximately 2300 feet long, by 500 feet wide. The total area of ground floor in the building was 17.8 acres, and that of the galleries, 5 acres.

It was built principally of cast and wrought iron, glass and wood, great saving of both time and money being accomplished by simplicity of details, and reduplication of parts. The total quantities used were as follows:

Cast iron, . . .	3,500 tons.
Wrought iron, . . .	550 "
Glass, . . . . .	896,000 superficial feet, and weighing 400 tons.
Wood, . . . . .	600,000 cubic feet.

The cost of this building and its fittings was £170,000, or say \$850,000.00, being about 3 shillings, 5 pence, per square foot of superficial area covered. It must be remembered however, that the contract under which the building was erected did not provide for its absolute sale to the Royal Commissioners, but was for "use and waste only." After the Exhibition closed, the building itself remained the property of the contractors. Had it been otherwise, the total cost would have been increased at least £100,000. The characteristic features of this building, which excited universal admiration and wonder at the time, were the "airy lightness of the whole structure," and the superb vistas afforded by a nave 1800 feet long, 72 feet wide, and 64 feet high, intersected near the centre of its length by a transept 408 feet long, 72 feet wide, and 108 feet high, to the crown of the semi-cylindrical roof.

Accompanying this report will be found the following books and drawings, &c. having reference to this building:

1st. A complete work called "Das Grosse Industrie-Ausstellungs-Gebäude, in London, 1851;" published by Förster, in Vienna, giving text and drawings of the plans and details of construction of the building.



2d. A set of 16 lithographs from the private collection of Messrs. Vincent Brooks, Day & Co. London, showing the various contracts entered into by the Royal Commissioners when carrying out the work.

3d. A set of 9 large colored lithographic perspectives showing both exterior and interior views of the various parts of the building as it appeared on different occasions.

4th. A section of one of the Parliamentary Maps, showing Hyde Park and surroundings.

## PARIS, 1855.

It is extremely difficult to convey a correct idea of this Exhibition without referring to illustrations of some kind, owing to the fact that the buildings varied in form and construction, and were irregularly located on the ground.

The following data will however serve our present purpose: The principal edifice was an extensive rectangular building, 820 feet long, by 360 feet wide, exclusive of the projections, in which were the stairways. The *whole building* covered about 8 acres of ground. It was situated on the south side of the Champs Elysées, and is now known as the Palais de l'Industrie. It was erected by a company in 1852 to 1855, and was intended to be a permanent construction. It therefore affords an example of how the French people erected a permanent memorial building as it were, in connection with a Universal Exhibition. It was built of stone, has galleries around the main Exhibition Hall, and roof of iron and glass. The present Director of the Building told me that experience had proven a great mistake to have been made in this latter respect, by providing *too much glass* and over-head light, and that much trouble had been experienced in consequence. All the other buildings used for this exhibition were temporary in character, viz.:

An annex for machinery, 4000 feet long by 85 feet wide, covering about 7.8 acres. This building was not expected to be so ungainly in proportions when the exhibition was first projected. Its greater length was essential to afford space that was required as the work advanced.

A circular building 330 feet in diameter, known as the Panorama Rotunda, covering about 2 acres.

A Palace of Fine Arts, of irregular plan, located at a considerable distance from the Industrial Palace, and covering over 4 acres.

The cost of these buildings was, so far as can be known, as follows:

Palace of Industry, . . . . .	12,500,000 francs.
Machinery Annex, . . . . .	2,602,000 "
Rotunda and Gallery, . . . . .	607,000 "
Fine Arts Building, . . . . .	1,051,700 "
Supplementary construction, . . . . .	105,800 "

Total, . . . . .	16,866,500 "
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Say \$3,373,300.

Accompanying this report will be found the following sources of information with reference to this exhibition:

The text and atlas of the "Allgemeinen Bauzeitung" for 1856, giving plans and details of the various buildings.

A collection of 10 lithographs of various sizes, giving exterior views of the whole exhibition, and interior views of the Palace and Machinery Annex.

## LONDON, 1862.

The principal part of the ground upon which the buildings for this exhibition stood was a tract about 16 acres in extent, which had formed a portion of the site purchased at South Kensington for the exhibition of 1851.

The main edifice was in general outline a rectangle, 1150 feet by 650 feet, but with greater width of 750 feet at the ends. It covered an entire area of  $17\frac{1}{2}$  acres, and was intended to be permanent in its construction. When preparing the design, provision was made to include the picture gallery, and care was taken to make the whole arrangement suitable for future international exhibitions. The exterior walls were built of brickwork, and hollow cast iron columns were used for the interior supports. The roof had both wooden and iron principals, and included two octagonal domes of 160 feet diameter each, with 260 feet external height to the top of the finials.

Adjoining this permanent building were two temporary annexes for the machinery department, covering an additional area of 7 acres, which, taken in connection with the main building, made the total area  $24\frac{1}{2}$  acres. These buildings enclosed on three sides the Royal Horticultural Society's Gardens.

In the principal structure the most impressive interior effect was obtained from the nave, 800 feet long, 85 feet wide, and 100 feet high to the ridge of the roof, over each end of which rose a dome 160 feet in diameter, and 200 feet clear interior height. These domes were at that time the largest ever constructed, St. Peter's, at Rome, being  $157\frac{1}{2}$  feet, and St. Paul's, at London, 112 feet. The dome of the Capitol, at Washington, has 94 feet  $8\frac{1}{2}$  inches interior diameter, and clear interior height of 180 feet 3 inches. The top of the figure of Liberty is 287 feet  $5\frac{1}{2}$ " above the ground at east front of the building. The domes on the London 1862 Exhibition building formed the most difficult and expensive part of the whole work. They weighed 120 tons each, and required an immense amount of timber scaffolding.

LIST OF SOME OF THE QUANTITIES USED IN THIS EXHIBITION.

Bricks, . . .	17,250,000
Cement and plaster, . . .	47,105 bushels.
Cast iron, . . .	4,953 tons.
Wrought iron, . . .	2,269 tons.
Timber, . . .	439,178 cubic feet.
Timber, . . .	2,238,722 lineal feet 9"x3" in plank, battens, &c.
Glass, . . .	667,542 superficial feet.
Stone, . . .	6,877 cubic feet.
Stone, . . .	62,831 superficial feet 6" thick and under.

Owing, however, to the omission of any expensive ornamentation, the actual cost was exceedingly low for the amount accomplished. The following are the principal items:

Contractors for the buildings, . . . . .	320,680
Designs, drawings, and superintendence, . . . . .	8,323
Roads and approaches, . . . . .	13,359

£342,362

The total cost of the Exhibition, including expenses during the period it was open, was £459,637—say \$2,298,185.00.

Accompanying this Report will be found the following, having reference to this Exhibition:

A general plan of the entire Exhibition and grounds, with the Royal Commissioners' Report.

Ditto, with further information in the "Allgemeinen Bauzeitung," Vienna.

A set of four rare photographs showing the interior. A most valuable description of the technical work involved in this Exhibition will be found in "Captain Phillpott's Lecture on the construction of the building," reprinted with additional matter as Appendix No. V., in the Report of the Commissioners for the Exhibition of 1862, published in 1863.

“This Exhibition was nearly four times as large as any that had preceded it, and was much more comprehensively organized.” As, however, the general features of the constructions are so perfectly familiar to all parties interested in enterprises of a similar nature, we propose in this place simply to give a few data for comparison. At the end of this report will be found stated some of the many important considerations which this remarkable Exhibition suggests.

The longer axis of the building, . . . . .	1,608	feet.
The shorter " " . . . . .	1,247	"
Length of straight galleries between the semi-circular ends, .	360	"
Circumference of the whole building, . . . . .	4,800	"
Total area within the outer limits of the building, . . . .	37.8	acres.
Of this the centre garden occupied, . . . . .	1.5	"
Amount remaining under roof, . . . . .	36.3	"

	Promenade around the centre garden,	17	feet wide, covering .48 acres.
1.	"Gallerie de l'histoire du travail,"	28	" " " .88 "
2.	Gallery of Fine Arts, . . . . .	49	" " " 1.38 "
3.	Corridor for the Liberal Arts, . .	20	" " " .83 "
	Passage way, . . . . .	16	" " " .72 "
4.	Corridor for furniture, . . . . .	76	" " " 3.9 "
	Passage way, . . . . .	16	" " " .92 "
5.	Corridor for textile fabrics, . . .	76	" " " 4.9 "
	Passage way, . . . . .	16	" " " 1.1 "
6.	Corridor for raw materials, . . .	76	" " " 5.9 "
7.	Gallery for machines, . . . . .	115	" " " 10.4 "
	Gallery for restaurants, . . . . .	33	" " " 4.89 "

The area of the Island of Billancourt used for the trials of Agricultural Machines was 52 acres.

An imperial decree placed the work under the direction of an imperial commission of sixty members, in June, 1865. The ground was given up by the Government, September 28th, 1865. The first iron pillar was raised April 3d, 1866. The work was *not* entirely finished at the time of the opening ceremonies, April 1st, 1867.

The total cost of the Exposition Building was 11,783,024 francs, say \$2,356,605.00

This was at the rate of 7 francs, 14 centimes, or say \$1.43 per square foot of surface covered.

The expenditure was for specific purposes as follows—taking 5 francs to the dollar:

Terraces, Masonry and Wood Work, 1,854,768f. 23c.	\$370,953.65
Iron Work, . . . . . 7,970,799f. 08c.	1,594,159.82
Roofing—Zinc, and Glass, . . . . 874,070f. 81c.	174,814.17
Painting, Plastering, Decoration, . 567,890f. 89c.	113,578.18
Flooring, flagging, doors, and various arrangements in the building, . . 205,697f. 34c.	41,139.47
Personal and General Expenses, . . 309,798f. 58c.	61,959.72

TOTAL, 11,783,024f. 93c. \$2,356,605.01

The sale of the building after the Exhibition closed realized only 1,200,000 francs, or \$240,000, (see extract from Baron Schwarz-Senborn's lecture, page 25.)

Accompanying this Report will be found the following:

The Report of the Imperial Commission, giving a complete description of the building in all its parts, and the official plan of the Exhibition.

The International Jury Reports—13 volumes.

A complete work by Anton Hanninger, Engineer, published by Waldheim, in Vienna, giving text and details of the construction of the building.

A collection of 40 panoramic photographs, lithographs, &c., &c., showing the Exhibition both as a whole and in detail.

## VIENNA, 1873.

(Continuation of previous Reports from Vienna, April 4th to May 26th, 1873, inclusive.)

### INDUSTRIAL PALACE.

Length of building, end to end, . . . . .	3,000 feet.
Width at centre permanent building, . . . . .	677 " "
Width at intermediate galleries, . . . . .	572 " "
Diameter of Rotunda on centre line of columns, . . . . .	343 " 9 inches.
Width of half gallery around the Rotunda, . . . . .	40 " "
Total clear width under Rotunda and half gallery, . . . . .	413 " "
Interior height of Rotunda to base of large lantern, . . . . .	158 " "
Ditto to top of large lantern, . . . . .	215 " "
Exterior height to top of crown, . . . . .	276 " "
Angle of roof with the horizontal, . . . . .	31°
Width of central nave, . . . . .	84 " "
Width of cross transepts, . . . . .	51 " "
Length of vista in nave on each side of the Rotunda, . . . . .	1,246 " "
Size of courts between the transepts, each, . . . . .	100'x240'
Number of such courts, . . . . .	28

### MACHINE HALL.

Length of building, . . . . .	2,620 feet.
Width of building, . . . . .	165 " "
Centre avenue, width in the clear, . . . . .	92 " "
Side avenues, " " . . . . .	28 " "

### AREAS.

Industrial Place:—

Area under Rotunda, . . . . .	2.2 acres.
" under Rotunda and half gallery, . . . . .	3.4 " "

Area of entire rectangular <i>permanent</i> portion, 677 feet square, including the four courts, . . . . .	10.5 acres.
Ditto, <i>excluding</i> the four courts, . . . . .	7.0 "
" of <i>temporary</i> portion of palace, including the 28 courts, . . . . .	32.3 "
Ditto, <i>excluding</i> the 28 courts, . . . . .	17.0 "
Total area of Palace <i>excluding</i> courts, . . . . .	24.0 "
Total area of Palace including all courts, viz.: area capable of being put under roof, . . . . .	42.8 "
Actual area under roof June 1st, 1873, . . . . .	35.0 "

## Machinery Hall:—

Area covered, . . . . .	9 acres.
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## Fine Art Gallery:—

Area covered and affording 30,800 feet of available wall length, . . . . .	1.5 acres.
Pavilion for amateurs—area, . . . . .	.4 "
Museum—area, . . . . .	.4 "

## Agricultural Buildings.

Three large frame structures, covering . . . . .	6.0 acres.
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Area enclosed by the fencing, . . . . .	286 "
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Total area on the Prater available for exhibition purposes, . . . . .	573 "
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The total weight of all wrought iron work for the Rotunda is 4000 tons. The columns rest upon foundations made in concrete (see first report) which were built in October, 1871. The contract for the Rotunda was taken by M. Harkort, a noted lattice-girder bridge builder of Harkorten, Prussia, and it stipulated that the supply of iron should commence on the first of January, 1872, and that the whole building should be finished by September 15th, of the same year. It is but fair to state, however, in this connection, that if the Rotunda had been built in accordance with the original sketches of MR. SCOTT RUSSELL, the weight of wrought iron necessary would have been but little more than *half* the above amount.

The following may be interesting for comparison: The dome of the Capitol at Washington, by MR. THOMAS U. WALTER, architect, contains 8,878,743 pounds, or 4439 tons of 2000 pounds each of *cast* iron. The total cost was \$950,000, which covered all brickwork and masonry, and a picture by Brumidi, \$40,000. It would be fair to assume that the actual cost of the iron work did not exceed 8 cents per pound.

(For cost of Vienna Rotunda, &c., see accompanying estimate.)

## SEWERAGE AND DRAINAGE.

The system of sewerage throughout the buildings and grounds, together with the most important work connected with the retiring rooms of the Exhibition, was designed and executed by MR. GEORGE JENNINGS, Sanitary Engineer of Lambeth, London, under the personal supervision of MR. JOHN PHILLIPS, C. E. The intention of the Austrian authorities at first was to allow each party to have their own cess-pool and separate arrangements, but a very short experience of the consequences compelled the adoption of a complete system which should be able to include all buildings within the enclosure. Stoneware pipes were used, with the joints laid in Portland cement. The main sewer leads into the Danube canal at a point say  $1\frac{1}{2}$  miles from the Exhibition. The various lines of pipe, sizes, grades, &c., we have shown upon the Situation Plan of the Exhibition. The Rotunda, roof, and inner side of the centre rectangle of the Palace is drained into 18

sunken wells. A 15" pipe, having four smaller ones leading into it, connects with each well. Each of these smaller pipes carries off its portion of the water which comes from the roof, after it has passed down through the large wrought iron boxed girders which support the Rotunda. There are four and sometimes five of these wells in each court. The arrangement is remarkably simple and satisfactory, for it must be remembered in this connection that the Rotunda, roof, and gallery has an immense exterior surface.

The machinery department has each boiler house drained into a sunken well located between the boiler house and the machinery hall. The machinery hall itself is drained at numerous points into wells located on the south side of the building.

The grades for the sewerage system are merely nominal, one in 700, and one in 1000, but sufficient to allow thorough washing out by water from a hose several times each week.

Cisterns were introduced in all the retiring rooms for the purpose of keeping uniform the strong pressure of water which comes from the "high service."

#### WATER SUPPLY—(ADDITIONAL.)

The water tower, elevation 110 feet, is located near the west end of the machinery hall. The tank had capacity of 10,000 cubic feet. The water is forced up into this tank through the centre pipe of the tower, and flows out at the top by several nozzles. It passes down through two of the outside supporting columns, which act as stand pipes, and are connected at the lower end with the one main which supplies the large system throughout the grounds. An accompanying drawing shows the system. The two steam pumps used for supplying this tower were manufactured at Brun, the capital of the Austrian Province Mahren, by the "Bruner Maschinen Fabricks Gesellschaft," 1873. They were arranged to work either separately or together, and can force into the tower 18,000 cubic feet per hour. When we last visited these pumps, about May 26th, they were working from 16 to 18 hours per day, and supplying 300,000 cubic feet per day to the Exhibition. They were performing in fact extra duty, which legitimately belonged to the pumps of the "low pressure" system, the latter not being in working order up to that date. The pump house was located at the northwest end of the machine hall, and the well from which the water was drawn was immediately in the rear of the pump house. This well was 20 feet in diam., and extended down 16 feet below the water level, say 26 feet below level of ground. It was lined with brick, resting upon a cast iron ring at the bottom. The method used in sinking this well was ingenious. The supply of water is apparently unlimited. The pumps and tower were manufactured by the same parties.

The two steam pumps for the "low pressure" service were located at the east end of the machinery hall. These were manufactured by "Eug. PRUNIER. Ingenieur et Conducteur, Lyon, France." The superiority claimed for them was their ability to supply with rapidity, their capacity being upwards of 20,000 cubic feet per hour. No well was necessary in connection with this system, as the pumps sucked the water directly from the ground itself, and forced it into a neighboring tank placed at an elevation 20 feet above the ground; capacity of tank, cubic feet. From this tank a line of pipes passed along the northern side of the machinery hall, and connections were made from it into the boiler house. This line of pipes emptied at the east end into the Henstadel Wasser, and a branch led into the agricultural department. The above system was not in working order up to May 25th, 1873.

In the rear of the Jury Pavilion were two steam pumps manufactured

by "GEBRUDER, DECKER & Co., Canstatt, No. 401, Patent 1873," in Witemburg, near Stuttgart. These pumps drew their supply of water from a well 12 feet in diameter, and sunken 20 feet deep, and working by means of an air chamber, were able to force up about 10,000 cubic feet per hour. This arrangement supplied all the fountains, and forced the water to a height of 70 feet through a nozzle  $2\frac{1}{2}$  inches in diameter. The nozzle most frequently seen in use for the large fountains was composed of one centre opening 35 millimeters in diameter, and 16 smaller openings around it of 15 millimeters diameter each. The water, after being forced through the fountains, was conducted back to the supply well and used again.

The above three systems of water supply were arranged to work either separately or, in case of emergency, in connection with each other.

#### RAILWAY COMMUNICATION—(ADDITIONAL.)

The "Stadtsbahn" and "Nordbahn" are connected by a line of single track which passes directly in front of the Exhibition R. R. station, an additional siding being introduced in the immediate vicinity of the station. From the station east, this track was built by the Stadtsbahn, the rest by the "Nordbahn." About three times as much freight for the Exhibition passed over the Nordbahn as from the Stadtsbahn, and strange to observe, there was but one main switch from the east or Stadtsbahn end, over which all freight for the Exhibition was obliged to pass. The arrangement answered its purpose however, up to about April 15th, over half a million cubic meters of gravel and building materials having been brought for the work on the Exhibition. During the two weeks previous to the opening, however, it proved entirely inadequate, so far as affording facilities for unloading in the immediate vicinity of the buildings. It was thought by the railroad officials, who evidently did not appreciate at that time what an immense business their Exhibition would occasion, that having made provision for unloading 250 cars per day easily, it was all that would be necessary. During the great rush, however, previous to the grand opening, experience enabled them to unload, when working night and day, 300 cars. The method adopted was about as follows: The wagons were arranged during the night, so that exhibitors could unload their boxes the first thing in the morning. Say 150 wagons were unloaded by noon, and then commenced the removal of empty boxes to the warehouses, and the bringing in of other freight. Four locomotives were at work night and day in the yard with these trains, and two more at the Stadtsbahn and Nordbahn ends of the road for similar purpose. 1300 wagons were frequently on hand at once, waiting to be unloaded during greatest rush, and required four to five days' time to distribute the accumulation. Much time was occupied in being obliged to send individual cars to separate parts of the building, and even separate articles from the same car to different points, thus delays occurred at the most critical time. The building itself was well provided with entrances, but the railroad facilities were not such as enabled them to be used to the best advantage. Experience proved that at least four tracks on each side of the Industrial Palace, and two on each side of the Machine Hall, would not have been too much for the work. There were nearly three German miles, equal to 15 English miles of track laid in the Prater in connection with the Exhibition work. One great difficulty undoubtedly was in the use of only one connection at the Stadtsbahn end. High grades and short curvature prevented any communication from the Nordbahnhof directly to the Exhibition.

A tramway for street cars was laid from the Prater Stern to a point near

the northwest end of the machinery hall; also over the Sophien Bruke to the Haupt Allee.

The accompanying papers and drawings give important information with regard to the Machinery Department, shafting, &c., &c., workmen's houses, restaurants, blacksmith shop, sanitary arrangements, watch houses, barracks, &c., &c., &c.

## COST.

## Detailed Estimate of the Cost of the Vienna Exhibition.

The principal items in this estimate are very nearly correct, as they have been compiled from the contracts made for the work. The accuracy of others cannot, of course, be known positively until long after the Exhibition closes.

Taking one florin as = 50 cents, we have:—

	FLORINS.	DOLLS.	CTS.
1 Industrial Palace, - - - -	6,289,018	3,144,509.00	
The Rotunda alone cost 1,000,000 florins, or \$500,000.			
2 Machinery Hall, - - - -	951,448	475,724.00	
3 Agricultural Hall, - - - -	670,000	335,000.00	
4 Fine Art Gallery, - - - -	742,000	371,000.00	
5 Amateur Gallery, - - - -	422,600	211,300.00	
6 Emperor's Pavilion, - - - -	20,000	10,000.00	
7 Covering of the Courts, - - - -	580,000	290,000.00	
8 Jury Pavilion, - - - -	144,000	72,000.00	
9 Manager's buildings, offices, - - - -	75,042	37,521.00	
10 Postal, telegraph, and custom buildings,	53,477	26,738.50	
11 Six large guard houses, - - - -	34,989	17,494.50	
12 Ten small guard houses, - - - -	40,904	20,452.00	
13 Infantry Barracks, - - - -	64,500	32,250.00	
14 Cavalry Barracks, - - - -	14,979	7,489.50	
15 Sutler's department, - - - -	8,700	4,350.00	
16 Fencing of Exhibition grounds, covered ways, &c., - - - -	292,000	146,000.00	
17 Water supply, including all forcing en- gines and water tower, - - - -	340,000	170,000.00	
18 Arrangements for working the Machinery Hall, such as boiler houses, driving engines, shafting, foundations, work- shops, &c., - - - -	603,400	301,700.00	
19 Provisionary buildings, - - - -	15,000	7,500.00	
20 Expenses of the building office, including salaries, gas rent, coal, &c., - - - -	345,000	172,500.00	
21 Preliminary work of the building office, drawings, &c., - - - -	40,000	20,000.00	
22 Building requisites, engineering instru- ments, stationery, &c., - - - -	12,000	6,000.00	
23 Delivery of the Rotunda, freight, &c., - - - -	22,800	11,400.00	
24 Drainage and water closets, &c., - - - -	147,000	73,500.00	
25 Fountains, - - - -	25,000	12,500.00	
26 Expenses for telegraph and gas arrange- ments, - - - -	36,800	18,400.00	
27 New annexes, - - - -	500,000	250,000.00	
28 Police service, gardens, and grading, rail- ways, &c., and military labor, - - - -	369,479	184,739.50	



29	Terracing, streets, roads, places of waiting for cabs and carriages, - - -	748,931	374,465.50
30	Sanitary provision—medical treatment by army physicians, - - -	4,681	2,340.50
31	Cashier's Office—a service at entrances,	4,314	2,157.00
32	Territorial indemnifications, - - -	12,156	6,078.00
33	Sundries, - - - - -	69,366	34,683.00
34*	General expenses of the central direction,	1,553,000	776,500.00
35	Price, difference of bricks, including tax of consumption paid to the municipality when passing through the city gates, - - - - -	95,000	47,500.00
36	Reserve fund, - - - - -	352,416	176,208.00
		<hr/>	<hr/>
		Florins, 15,700,000	\$7,850,000.00

## LIST OF BUILDINGS WITHIN THE ENCLOSURE.

*From the Official Plan of the General Direction of the Exhibition.*

*Official Plan of the World's Exhibition, Vienna, 1873.—Edition of the General Direction.  
—Translated from the German, by W. H. Burr, C. E.*

## MAIN EXHIBITION—BUILDINGS AND SIDE BUILDINGS.

I. Industry Palace with the Rotunda.	X. Offices of the Direction.
II. Machinery Hall.	XI. Postal Telegraph and Customs.
III. Art Gallery.	XII. Barracks.
IV. Pavilion for Art.	XIII. Building for the Exhibition of Horses.
V. Exhibition of Amateurs.	XIV. Railway Station.
VI. Western Agricultural Hall.	XV. Guard Houses.
VII. Eastern Agricultural Hall.	XVI. Water Closets.
VIII. Jury Pavilion.	XVII. Covered Ways of Communication.
IX. Emperor's Pavilion.	

THE PLAN IS DIVIDED INTO 4 ZONES. EACH ZONE HAS ITS OWN NUMBERING.

## FIRST ZONE.

- 1 American Restaurant.
- 1½ American School House.
- 2 Beer Hall of the Citizen Brewery Pilsen.
- 3 Beer Hall of the Pilsen Joint Stock Brewery.
- 4 Hungarian Wine House, (Czarda.)
- 5 American Drinking Hall.
- 6 Pavilion of the "New Free Press."
- 7 Swiss Confectioners, by Possard of Zürich.
- 8 Pavilion of the Musical Box Manufactory, by Heller, in Bern.
- 9 Beer Hall of the Brewery of Liesing, near Vienna.
- 10 French Restaurant.
- 11 Pavilion of Prince Monaco.
- 12 Pavilion of the Finsponk Domain.
- 13 Swedish School House.
- 14 Swedish Army Exhibition.
- 15 Swedish Hunting Pavilion.
- 16 Gothic Mausoleum, by Wasserburger.
- 17 Boiler House for the Water Supply, Brothers Decker & Co. of Canstatt.
- 18 Kiosque of the Southern Railway.
- 19 Kühn's Portable House, (dwelling.)
- 20 Pavilion of the 1st Austrian Savings Bank.

\* This is the item of expense which occasioned so much severe criticism by the press of the country, and in regard to which the most spirited debates took place in the Austrian Parliament. Accompanying this Report will be found the record of the final debate.

- 21 Mr. Stark's Pavilion.
- 22 Pavilion of the Little Child.
- 23 Restauration of the Brothers Provençaux, Paris.
- 24 Reading Room,        }
- 25 Restaurant,         } of Natale Biffi, from Milan.
- 26 Wine House,         }
- 27 "Eisen Hof," Hall for the Exhibition of Metal Industry.
- 28 Pavilion of the Austrian Healing Springs.
- 29 Pavilion of Tobacco and Cigar Specialities.
- 30 Pavilion of the Perlmöser Cement Ware Manufactory of J. Neumüller, in Nussdorf.
- 31 Russian Restaurant, by Engel, in St. Petersburg.
- 32 Wine House of Steiermark, (Austrian Province,) of the Steiermark Vinyard Company of Gratz.
- 33 Russian Dwelling-House.
- 34 Exhibition of the Austrian Lloyd.
- 35 Wigwam. Restaurant.
- 36 Iron Forcing House, by R. Ph. Wagner.
- 37 Palace of the Viceroy of Egypt.
- 38 Little Japan—Buildings and Gardens.
- 39 Dr. Hardt's Oriental Circle.
- 40 Turkish Dwelling-House.
- 41 Turkish Bazaar.
- 42 Turkish Coffee House.
- 43 Persian Dwelling-House.
- 44 Exhibition of the Imperial and Royal Ministry of Marine.
- 45 Lighthouse, by Sautter & Co. of Paris.
- 46 House of the Photographic Association.
- 47 Dairy of the Imperial and Royal Farming Co.
- 48 Pavilion for the Reception of the Sick.
- 49 Building Court.
- 50 Italian Restaurant—Iron House, by S. C. Hemming & Co. of London.
- 51 Exhibition of the Imperial and Royal Horticultural Society.
- 52 Pavilion of the Iron Furniture Manufactory, of Quittner & Herzog.
- 53 Gardeners' Dwelling.

## SECOND ZONE.

- 1 Lighthouse.
- 2 Fountain. Sultan Achmed II.
- 3 Triumphal Arch of the Wienerberg Brick Manufactory.
- 4 Russian Peasants' House.
- 5 Pump House.
- 6 Iron Church.
- 7 Swedish Dairy.
- 8 Pavilion of the Administration of the Royal Hungarian "Woods and Forests."
- 9 Pavilion of the Steiermark Owners of Woodlands.
- 10 Saxon Peasants' House.
- 11 Szekler " "
- 12 Austrian School " "
- 13 Vorarlberg Peasants' House.
- 14 Austrian Gymnasium.
- 15 Pavilion for Glass Painting.
- 16 Slovatian Peasants' House.
- 17 Croatian " "
- 18 Roumanian " "
- 19 Gaydelian " "
- 20 " " " " } From the neighborhood of Presburg.

## THIRD ZONE.

- 1 American Restaurant.
- 2 Vienna Bakery, by Roman Uhl.
- 3 English Workman's Dwelling House.
- 4 Pavilion for Seed.
- 5 Water Tower for the High Water Service.
- 6 Iron House, by S. C. Hemming & Co., London.
- 7 Swedish Restaurant.
- 8 Norwegian } Fishery Exhibition.
- 9 Swedish }

- 10 Norwegian Garden Kiosque.
- 11 German Teaching Pavilion.
- 12 Germany's Pavilion of Industry.
- 13 German Exhibition of Mining Industry.
- 14 Tasting Room of the Dreher Beer Brewery.
- 15 Pavilion of the Duke August of Coburg Gotha.
- 16 Pavilion of Prince Schwarzenberg.
- 17 Pavilion Mauthner.
- 18 Stable Building, by R. Ph. Wagner.
- 19 Curtis Obelisk of Cement.
- 20 Little House of Artificial Stone, by Chailly.
- 21 Vorderberg }
- 22 Innerberg } Exhibition of Mining Industry.
- 23 Kärntner }
- 24 Pavilion of the Joint Stock Brewery of Silbereg. (Kärntner).
- 25 Joint Stock Machine Building Company, formerly Danek & Co., Prague.
- 26 Tar and Asphalte, by J. Bosch.
- 27 Building Ornaments of Zinc, by Vinc. Wenzel.
- 28 Steffen's Exhibition of Machinery.
- 29 Rothschild's Bridge Building.
- 30 " Machinery Exhibit.
- 31 Slate Exhibit, by Jno. Liebieg.
- 32 Wood Ware, by Schuberth.
- 33 States Railroad Pavilion.
- 34 English Restaurant, by Abel Moser and Posse. (Iron House.)
- 35 Pavilion of the Joint Stock Company for Bridge and Street Building.
- 36 Tyrolese House. (Wares of Carved Wood.)
- 37 Additional Exhibition: Contributions to the History of Trades and Inventions, and Pavilion for Women's Work.
- 38 Pavilion.
- 39 Pavilion of the Imperial and Royal Private Austrian Danube Steam Navigation Co.
- 40 Alsatian Peasant House.
- 41 Exhibition of the Imperial and Royal Ministry of Agriculture.
- 42 Wine Tasting Hall of all lands.
- 43 Sacher's Restaurant.
- 44 Pavilion of the Joint Stock Company for Forest Industry.
- 45 Pavilion of the Archduke Albert.

FOURTH ZONE.

- 1 Bakery by Heilfinger.
- 2 Boiler House.
- 3 American Boiler House.
- 4 English Workman's Dwelling House.
- 5 " Boiler House.
- 6 " Workman's Dwelling House.
- 7 French Boiler House.
- 8 English Gas Factory.
- 9 Gas Company, limited.
- 10 Belgian Workman's Dwelling House.
- 11 Machinery Workshop.
- 12 Swiss Boiler House.
- 13 Belgian Boiler House.
- 14 Pavilion of the World's Trade.
- 15 German Boiler House.
- 16 Germany's Pavilion for Brick Kilns and Ice Machines.
- 17 Austrian Boiler House.
- 18 Pavilion of the Northern Railway.
- 19 " " North West Railway.
- 20 Boiler House for the Water Supply.
- 21 Pavilion Ringhofer.

LIST OF PAPERS, DRAWINGS, ILLUSTRATIONS, &C., CONCERNING THE VIENNA EXHIBITION OF 1873, ACCOMPANYING THIS REPORT.

Translations from the German, by MR. W. H. BURR, C. E., of BARON SCHWARZ-SENBNORN's lecture before the Engineers' and Architects' Association of Vienna; "Notes

concerning the Great Rotunda," by Inspector HEINRICH SCHMIDT; "The Building for the Exhibition of 1873," from the Journal of the Engineers' and Architects' Association.

A complete set of the official Programmes of the Exhibition. Special orders of the General Direction.

A complete set of the forms, blanks, drawings, &c., used by the British Commission in transacting business with exhibitors in their own department, and with the Austrian General Direction. Presented by P. CUNLIFF OWEN and A. I. R. TRENDALL, of the Royal British Commission.

A series of articles written by MR. GEO. C. V. HOLMES, resident Engineer of MR. SCOTT RUSSELL, at Vienna, giving full detailed description, with accompanying drawings, of the construction of the Exhibition buildings. Published in London "Engineering" from January 3d to May 16th, 1873.

Throughout both volumes XV. and XVI. of "Engineering" will be found very valuable contributions concerning the technical part of the Exhibition. A complete work devoted to the same purpose will be issued by MESSRS. MAW & DREDGE, editors of "Engineering," after the Exhibition closes.

A set of 80 lithographic *working drawings* of the Exhibition buildings. Presented by BARON SCHWARZ-SENBORN.

A collection of 130 photographs taken by the Vienna Photographic Association, showing the progress of the work and final appearance of the Exhibition.

A collection of 33 specimens of the canvas or jute printed decorations of the various buildings, being pieces of the actual decoration for the Palace.

A collection of 11 chromo lithographs, showing the appearance of the city of Vienna during the continuance of the Exhibition.

Maps, catalogues, flags, &c., &c.

Also:—

Published works, lithographs, photographs, and illustrations with regard to the following:

Munich Exhibition, 1854.

Sydenham Palace, London.

Alexandra Palace, London.

Art Treasurers' Exhibition, Manchester.

Conservatory, Covent Garden Theatre.

Oxford Music Hall, London, &c., &c., &c.

A FEW PRACTICAL CONSIDERATIONS  
CONCERNING THE  
UNITED STATES CENTENNIAL BUILDINGS,  
PHILADELPHIA,  
1876.

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We will not occupy time by restating the main points already decided by the Committee on Plans and Architecture, but simply present, under as few heads as possible, some suggestions in regard to the most essential matters for consideration at this stage of the Centennial work, and in course of our remarks make frequent allusion to what has been already done abroad in settling similar difficulties.

THE PREPARATION OF AMPLE ACCOMMODATION FOR ALL EXHIBITS THAT MAY  
BE SENT.

As one of the great ends for which International Exhibitions are held, is to properly display the various objects contained in the buildings, it will at once be acknowledged, that in order to do so satisfactorily, it is of no small importance to have as much information as possible both as to the number and kind of the exhibits that must be provided for. In this respect no other International Exhibition has ever been undertaken with so little information and precedent, *from native sources*, as the International at Philadelphia in 1876.

Therefore, owing to this primary fact: that it is impossible to know positively, at this early stage of the work, the exact kind of exhibits that will be sent, or the area in square feet each State or Country may need, the buildings should be so designed as to meet further requirements that may arise during the progress of the work. The importance of this was fully appreciated in designing the buildings at Vienna.

When the original sketches for the Industrial Palace were first presented for criticism, it was distinctly stated that the expansion or adaptation of the building to future requirements could be accomplished in two ways, either by extending the transepts in length, or by a judicious use of the intermediate courts. The first supposition proved fallacious, and we think fortunately so for the appearance of the edifice. MR. HASENAUER, the chief architect, being a man of both taste and tact, saw instantly that if the transepts were extended to various lengths, the result would be utterly ruinous to the general architectural effect of the whole design, and he prevented the possibility of any such action being taken, by putting permanent ornamental facades, in keeping with the central feature of the building, at the extremity of each transept. With regard to the courts, however, the

case was different. These courts were intended not only for the display of those exhibits from the Country in the adjoining transepts which could be shown in the open air, but also to afford opportunity to gain area under roof if required, and experience has proven that such area *was* required in almost every instance.

For our own guidance we have no precedent by which we can judge so long previous to the opening of our exhibition, as to how much space each State and foreign nation will need. It is altogether a matter of individual judgment. Although we do know, for instance, how much per cent. of the whole area of the Paris building, or the Vienna building was occupied by the United States, yet it does not at all follow that either France or Austria will require the same per centage of space in our Industrial Palace. The Philadelphia buildings should undoubtedly be adapted to the proper display of all offered exhibits that are found to be proper and suitable for admission, the more instructive and novel the better; but so long as neither their kind or number can be positively known, the building should be capable of adaptation to the great demands that will undoubtedly be made as the work progresses. It has frequently occurred at previous exhibitions that some of the most interesting articles have been offered for exhibition during the last six months previous to the grand opening. We would refer to the list of the various building and annexes forming the Vienna 1873 Exhibition, which accompanies this paper. Even a rapid glance at this list will convince any one of the immense variety and large size of the exhibits represented. By comparing this list and the final official plan of the Exhibition and grounds, with the early drawings of the Direction, it will at once be recognized how the demand for space both in the building and on the grounds increased as the work advanced, far beyond the most sanguine expectations of the officials in charge. In one of our reports from Vienna, we wrote as follows, which corroborates the above: "When the buildings were first located it was considered by the General Direction that ample space had been left on the intervening grounds for all extra buildings, but experience has shown that it would have been far better to have made greater allowance. The demand for building sites has been continually on the increase as the 1st of May, 1873, approached, and consequently the authorities have been at loss to know where to provide sites for the numerous buildings that different nations and private parties are desirous of erecting. The piece of ground between the Industrial Palace and Machinery Hall, originally intended for walks and fountains, is now so densely built up that it resembles a Swiss settlement, with the houses arranged to face the main building.

"In order to obtain space, it has also been necessary to roof in all the open courts on the side of the Industrial Palace next the Machinery Hall, and we notice that lately some of the front courts are treated in the same manner."

#### ADAPTABILITY TO THE SITE IN FAIRMOUNT PARK.

It has been very gratifying to Americans connected with the Centennial Commission, to observe the universal acknowledgment by all European engineers and architects who have examined the topographical map prepared by the Park Commissioners, of the adaptability of the site chosen, to the purposes of an exhibition. The capabilities of the Park being once appreciated, it only remains for the Commission to make the most of the site for the Exhibition. Fortunately there is no reason why, when locating the various buildings, boulevards, terraces, fountains, etc., such work should not be done as will meet the requirements of the occasion, and at the same time permanently improve the Park.

In this respect we would first call attention to the location of the Memorial Hall, as when that point is once settled definitely, other secondary considerations will be found to adjust themselves. It will be remembered that the tract of ground chosen by the Commissioners, and marked A on the Park map, slightly rises from all directions towards its centre. This necessitates locating the Memorial Hall so that when it is left as an isolated building, it may stand well upon the ground, the higher up the better, as is the case at Sydenham or Alexandra Palaces, near London. This unevenness of the ground also seriously affects the choice of a plan for the Industrial Palace, because on no consideration should the form of the temporary building be such as to force the permanent Memorial building out of its rightful position, viz: the best site on the ground. Future generations it is to be hoped will visit our Memorial Hall long after the temporary portion has been removed, and we owe it to them, if not to ourselves, to leave the permanent part of our Centennial work as well located as possible.

The large illustrations accompanying this paper, show clearly the superb appearance of Sydenham and Alexandra Palaces, in consequence of their being admirably located at the highest portion of the ground. The treatment of the site at Sydenham in particular, shows great forethought and skill on the part of the management, in availing themselves of the natural advantages of the ground. With regard to a site for our own buildings, we would respectfully make the following suggestions:

Standing at the highest point of the site marked A on the Park map, which tract has been definitely decided upon for the Industrial Palace, the conviction has forced itself upon us, that there are four different directions, exactly opposite and at right angles to each other, towards each of which some imposing part of our Palace should face, viz: towards Elm Avenue, towards the long view up the Schuylkill, towards George's Hill, and towards the Art Gallery.

A view of the exterior of our Industrial Palace from any one of the above four directions should be an impressive one, because it will be proper from the very necessities of the case to provide the largest portals for the general admission of the public on those four sides, and the question of approach must be thought of. The Paris building, 1867, made but little pretension in this respect. Vienna, 1873, has an imposing approach towards the main entrance only. Sydenham, 1854, has the most imposing of all, when entered from the terrace. Philadelphia, 1876, has an opportunity to accomplish more than either.

Whether or not our Palace shall produce a favorable and impressive effect upon the visitor as he approaches it from a distance, deserves the most careful consideration. It seems to us that it should undoubtedly influence the final selection of a plan, for if we must spend immense sums of money, let us have a building which is capable of appearing to advantage when seen from all directions.

We have an immense amount to learn from our European friends in regard to the location of our public buildings, and we would most earnestly impress upon the Commission the importance of the proper placing of our Industrial Palace on the ground. The adoption of any plan that would necessitate a bad location for the Memorial Hall would be a blunder far worse than a crime.

Extending our remarks from the Industrial Palace proper, to the general treatment of the whole of that portion of the Park which has been donated to Centennial purposes, we would suggest the following as the governing features in the arrangement of the Exhibition:

The Industrial Palace being finally decided upon, both as to general plan and location, connect it with George's Hill by means of a wide

boulevard, one hundred (100) feet in the clear for vehicles, and fifty (50) feet on each side for pedestrians and equestrians. This boulevard to have at the very least three (3) rows of trees on each side, and to be capable of brilliant illumination at night by several rows of gas lamps on each side, with intervals between the lamps of not more than forty (40) feet. The Champs Elysées at Paris to serve as the model for the details of construction; and the system of watering as applied to the main drive along the Cliff at Brighton, in England, to be introduced. The idea for the treatment of George's Hill, viz: to locate on the plateau above, a permanent building of artistic merit, affording a pleasant resting place, and point of sight for seeing the whole Exhibition below, and to form a series of terraces, fountains, etc., leading down to the boulevard, was first suggested to us as far back as last winter by MR. H. J. SCHWARTZMAN, Landscape Architect of the Fairmount Park Commission, who at that early time had partially developed a design for the treatment of that portion of the grounds. MR. SCHWARTZMAN's idea, if carried out, will be undoubtedly just the right thing in the right place, and it can be accomplished at a comparatively small cost, compared with the great results to be attained. The building and terraces would not only be beautiful in themselves, but afford a prominent point of universal interest at the opposite end of the Exhibition Grounds from the Industrial Palace. The boulevard would become the general thoroughfare inside the Exhibition Grounds, and present an appearance as gay as the Haupt Allee, at Vienna. If at the same time the Machinery Department should be located on the tract south of the boulevard, and the various out-door exhibits of private enterprise arranged so as to bring those which are most attractive into prominent positions along the north side, and on the slope of the hill towards the reservoir, the view from George's Hill would rival that of the Champs de Mars, in 1867, from the Trocadero.

The Horticultural Department, if located on Lansdowne Terrace could be connected with the main boulevard by an avenue, which should lead down on the same centre line as the Horticultural buildings themselves, which avenue would intersect the boulevard at a point about the centre of its length. This intersection could be improved as at the "Round Point" in the Champs Elysées. The Belmont Avenue could be retained, with increased width, for street cars, vehicles, equestrians and pedestrians.

The above mentioned points furnish but an outline of one system of arrangement, but quite sufficient for present purposes, to prove that the site is capable of such treatment as would give us many good points not found at any previous Exhibition.

If some such general features are adopted *soon*, the result will be that a clear, well-defined intention will be stamped upon the work at its very start, and system will be evident throughout. Each part of the Exhibition will not only appear well in itself, but be recognized as forming part of one grand design.

Such action will also inspire confidence in the public as to the success of the Centennial movement much quicker than any other means, by giving the public a clear and satisfactory idea, illustrated by pictures distributed throughout the country, that their money is being spent in producing grand results, creditable to the country in 1876.

We have spoken incidentally of the Machinery Hall as being located on the south side of the main boulevard, viz: between it and Elm Avenue. The circumstances are such that the most direct railroad connection can be obtained upon that side, and as the area is ample for our purpose, it seems



evident that the Machinery Hall should be so placed. The location for the Agricultural Machinery Halls can only be judiciously decided upon when more is known as to how extensive they must be, and what interior arrangements may be required. Whether, for instance, they shall contain implements and machines standing quietly in position, as usual in European exhibitions, or in motion, as has been done at the Cincinnati Industrial Exhibitions, of which MR. A. T. GOSHORN, Director General of the United States Centennial Exhibition, has been President. The same remark is also true with regard to all buildings required in connection with cattle shows, trials of speed of horses, trials of agricultural machines, warehousing of boxes, etc., etc. The reports and drawings accompanying this paper, show how each of these departments was provided for at Vienna.

THE APPLICATION OF THE DUAL SYSTEM OF CLASSIFICATION, AND PLANS OF EXHIBITIONS.

The following points with regard to the application of the dual system of systematic and geographic classification, have been suggested to us in various conversations with parties who have had experience in previous Exhibitions. The dual system can be applied to any covered area, which has a proper width in proportion to its length, whether it be rectangular, circular, segmental or elliptical in plan, and in each case either system can run either way; but there will be found no one plan which is so complete that serious objections cannot be urged against it. We do not propose in this paper to discuss the relative merits of any of the various arrangements that have been proposed, but simply to call attention to some of the difficulties to be overcome in any building having curved corridors or a ground plan more or less rectangular in form. The Commission can best decide which shows the greatest capability for adaptation to our wants.

We quote the following passage from BARON SCHWARZ-SENBORN's lecture before the Engineers' and Architects' Association of Vienna. He said: "You will remember that the monotony of the building of Paris, 1867, was perfectly awful. It resembled a gigantic gasometer, and made but very poor impression on the mind, certainly no such impression as was created by the Exhibition building of 1851, in London."

Again, the curved galleries used at Paris, in 1867, produced considerable inconvenience in carrying out the dual classification, in consequence of the radial segments being smaller at one end than at the other.

It is not a satisfactory answer to this last remark to state that in cases where the exhibit was very large, it was extended into the neighboring segment, because as soon as that variation is considered admissible, the clearness of the system is lost, and the whole arrangement becomes confused and "unphilosophical."

Again, curved corridors often occasion extra expense in the construction, and what is of much importance for our consideration, they will be found much more difficult to be disposed of by sale, after the Exhibition closes, than if not curved.

Also, in the opinion of many, the interior effect from a curved gallery or corridor, prolonged to a great length, is so confusing that the public often become uncertain as to which part of the curve they may be in at the time, and locomotion through the building then becomes very unsatisfactory. We have had this remark corroborated by many different parties who experienced annoyance in Paris, in 1867. The latter difficulty can be entirely overcome, however, by the introduction of naves or straight galleries intersecting the curved galleries, in which case the naves serve as points of reference when moving about in the building. This idea was

much favored by BARON VON WEBER, the eminent Saxon engineer, who has represented his country at very many of the leading exhibitions in Europe. BARON VON WEBER suggested, for our purpose, an adaptation of the Paris building of 1867, which could be made by separating that structure along the centre of its shorter axis, and inserting between the two halves a lofty nave. The ends of the naves to be treated architecturally, and the centre part of it, or the whole if desirable, to be designed to form the permanent Memorial Hall. This idea he thought could be developed so as to include most of the advantages to be found in previous exhibition buildings.

There is, however, one class of curved buildings which does away with the defects incident to curved galleries and corridors, viz: those which like the Vienna Rotunda, are constructed so as to bring the whole exhibition under one immense roof. The greatest living advocate for such constructions, is MR. SCOTT RUSSEL, who prepared the original design for the Vienna Rotunda. MR. RUSSEL described to us, 'as perfectly feasible, the construction of an Industrial Palace for our Exhibition, which should allow all the exhibits to be placed under a single roof, of one thousand (1000) feet span if necessary; which roof should be an example of MR. RUSSEL's system of conical roof construction. For a graphic account of this method of construction, which was proposed by MR. RUSSEL for the erection of the Rotunda, at Vienna, but not adopted by the Austrian authorities, we would refer to an article written by MR. G. C. V. HOLMES, MR. RUSSEL's resident engineer at Vienna, which was published in the London *Engineering* for March 14th, 1873. By keeping this idea of one immense conical roofed building in view, and referring back to the suggestions given in our Report from Vienna of April 28th, 1873, you will have the key to the motive which originated MR. RUSSEL's remarks in his conversation concerning our Palace. Whether or not such a building would be desirable for our purpose, the Commission can best decide.

Buildings more or less rectangular in plan do not, as a general thing, concentrate all the exhibits around one central forum or meeting place, nearly as effectually as a building having curves, and the importance of providing some such central meeting place, be it a rotunda, dome or nave, with the buildings properly arranged in connection with it, is very great. "After all, the most interesting study to human beings is human beings themselves," and that exhibition building which affords the most satisfactory opportunity for people see each other and appear to each other to the best advantage, will be in a fair way to great popularity from that single fact alone. A good opportunity to study human nature in this respect can be seen at the Crystal Palace at Sydenham, where, although there are so many objects of artistic merit throughout the building, yet the crowd seem to care but little for such exhibits, and attend much more frequently "to spend a happy day," than to examine critically what is around them. All exhibitions are attended, more or less, for this same reason, and the popularity of such undertakings very much depends upon having a building so constructed that people can be entertained when *en masse*.

Indirectly connected with this subject there is this thought also for consideration. A large item of expense, probably much more than will be realized at first, can be avoided by making the Memorial Hall so much of the integral part of the ground plan of the whole Industrial Palace that it can be utilized by placing some portion of each Department, or each country, in it. So many acres of temporary buildings can be thus saved. If the Memorial Hall does *not* form an integral part of the ground plan, it will be extremely difficult to use it in connection with the dual system of classification.

At Vienna the permanent portion of the Industrial Palace, viz: the rotunda and square galleries, including the four largest courts, *did* form an integral part of the general plan of the building. Also at Paris, in 1855, the permanent Industrial Palace was used for the display of the various departments.

We would most respectfully suggest a very thorough consideration of this point in all its bearings, particularly as there is a very decided opinion expressed by many, in favor of making our Memorial Building so entirely separate and distinct, as not to be utilized in furnishing available area for the application of the dual classification. Such would undoubtedly be a most expensive plan to carry out, and it is very questionable whether we could succeed between now and 1876 in executing in a creditable manner, so ambitious an undertaking.

FURTHER CONSIDERATIONS WITH REFERENCE TO THE MATERIALS AND SUPER-  
STRUCTURE OF THE BUILDINGS.

We shall obtain a clearer idea of what we can accomplish in this respect, by first finding out what materials we have at our disposal, and secondly, by noting some general lessons to be learned from the construction of other exhibition buildings.

It will be acknowledged by any one gifted with common sense, that we can build the cheapest, quickest and best, with the materials we are in the habit of using; and those materials are brick, colored stones and marble, iron, slate, glass and wood. The item bricks including terra cotta and tiles of various forms and colors. The list is a long one and speaks volumes as to the resources of the country in building materials.

Perhaps it is not too much to say, that in our Exhibition buildings we can use, in a greater or less degree, any or all of the above materials, and still keep within the limits of our moderately skilled labor, and command a good class of work.

Just in this connection we will renumerate some of the principal materials used for previous exhibition buildings: London, 1851, was built principally of iron and glass, with wooden floors. The Munich, 1854, and Sydenham Palaces stand to-day with the same construction. London, 1862, and the Alexandra Palaces have exterior walls of brick work, and cast iron columns for the interior supports, both wood and iron being used in the roof. Paris, 1867, had also brick walls and wooden floors, with iron used extensively, but in a way that was radically different from that in London, in 1851.

The following extract from BARON SCHWARZ-SENBORN's lecture, explains itself. When speaking with regard to the Paris building, of 1867, being saleable after the Exhibition closed, he remarks:

"The Government of Wurtemberg was desirous of purchasing one part of the building and putting it up again in Stuttgart, so as to use it for a Trades-School-House. MR. PRESIDENT VON STEINBEIS went on to Paris, accompanied by two other Engineers, but when he arrived there, he was forced to declare his opinion that it was impossible to carry out the idea, because it would cost more to break up the old building than it would to erect a new one in Stuttgart. The reason of this was, that the whole structure was rivetted together, and all the old rivets would have had to have been taken out. On this account the Commission of the Exposition sold off the old building merely as old iron. It was broken up into proper lengths and sold at thirteen (13) centimes the kilogramme, realizing for the whole only one million two hundred thousand (1,200,000) francs; by which transaction the contractors for the demolition made only from sixteen (16)

to eighteen (18) thousand francs, their expenses being very heavy on account of the high rate of wages."

With regard to the various materials used in the Vienna buildings, we would refer to our first report, and remark here, that rough brick walls with plaster finish, iron lattice posts and roof trusses, with wooden and zinc covering, predominated.

The illustrations accompanying this paper, show what effect was obtained in each case. There is one lithograph, however, of the interior of the Brighton Aquarium, which is intensely suggestive to us as to what *we can* accomplish by a most effective use of very old means. This lithograph shows the great effect that may be obtained by the proper introduction of colored and glazed bricks, in connection with terra cotta and tiles. This Brighton Aquarium furnishes a suggestive example of a style of work in which we ought to excel, and which is extremely effective when properly introduced. An example of such brickwork is to be seen on the north side of the new Academy of Fine Arts, Philadelphia, by MESSRS. FURNESS & HEWITT, Architects, and several admirable specimens have been executed at Central Park, N. Y. There are many Americans to whom the brilliant colors that are to be found upon the terra cotta or brick construction of some of the oldest Italian cities, would be a new revelation, if reproduced in our Centennial Buildings. Fortunately it is quite within our ability to produce with moderately skilled labor, and at a reasonable cost, a similar effect.

With regard to the use of our plain red bricks, the question may as well be stated plainly and without affectation. It will be much better to leave brick entirely out of consideration, when working up the design for our buildings, if in using them we shall be compelled to reproduce the intensely monotonous and unbearably stupid work that is to be seen around us already. As, however, the facts of the case are these, viz: that we *can* build quicker and cheaper in brick than in any other manner, and it is unreasonable to expect that such an immense construction as our Industrial Palace shall not be partly made of bricks; it remains for us to use them in the most effective manner possible. Taking all into consideration, it is fortunate we have such materials and labor equal to the emergency. It would be found for instance a physical impossibility to reproduce the superb designs, with bas reliefs in stucco and plaster, that form the exterior decoration of the Vienna building. The skilled labor which has been especially educated to that business for years, we could not command, to say nothing of the difficulty of obtaining sand of the peculiar quality used in the Vienna plastering, which is found in such abundance near that city. Also with regard to the immense amount of rivetted iron work used in the construction of both the Paris, 1867, and Vienna, 1873, buildings, we may just as well consider such construction as beyond our reach, both on account of the time required to execute it, and the great cost of such work in this country.

In the many points to be observed in the construction of previous exhibition buildings, there are none more important for our consideration than those referred to by BARON SCHWARZ-SENBORN in his remarks to the engineers and architects of Vienna. We therefore quote again from that valuable paper. Speaking of the London, 1851, Exhibition the Baron says:

"I will not call your attention now to all the inconveniences and deficiencies which were found to exist in that building. One of the greatest however, not only here, but also in all later exhibitions, was the leaking in of rain through the roof, whereby a great number of the objects on exhibi-

tion were damaged. This was a defect which occurred in a far greater degree in the year 1867 in Paris. Another objection was the galleries, which are always a source of trouble in an exhibition building. They caused much trouble and annoyance, both by the dust which they were the means of raising throughout the building, and by difficulty of access and installation. In addition to that, it became very evident that the number of people who visited the galleries, compared with those who circulated in the lower part, was an exceedingly small one indeed."

"Another very perceptible inconvenience was the insufficiency of doors, which was the cause of much confusion, especially during the fourteen days previous to the opening of the Exhibition, when the greatest shipments of goods arrived at the doors of the Exhibition at one time."

"I have seen in London, in the years 1851 and 1862, and in Paris, in 1855 and 1867, the time during the last few days before the openings, when there have been such quantities of wagons and railway carriages, standing outside of the doors of the Exhibition, that they have been kept waiting from six to eight days and nights, because they could not be unloaded, there being no sufficient space for the purpose. On account of the too few entrances, the empty boxes could not be got away quick enough."

"Another objection lay in the grouping of the countries. The Exhibition building was so divided that one half of the space was given to the home country, England or France, and the other half to foreign countries. The consequence of that arrangement was, that the goods of one nation were dragged through the space of another, boxes often went astray and had to be looked for through all kinds of foreign departments."

"The want of sufficient light, or rather I should say the unequal distribution of the light, was another drawback. Many portions of the buildings had too much light, whilst others were quite in the shade. This circumstance gave rise to a great many complaints."

We regret, however, to have to add to this extract from the Baron's lecture, that all the above difficulties were not avoided at Vienna. For instance, the leak of rain through the roof was not prevented. On one occasion after a storm, we, ourselves, counted seventy-eight separate leaks through the plate iron roof of the Rotunda, the canvas lining, however, protected the articles below. We have learned also since leaving Vienna, that during the prevalence of some heavy storms, many of the courts and galleries were found very imperfect in keeping out the rough weather. With regard to the provision of numerous doors, however, for entrance and exit, the Vienna Industrial Palace undoubtedly does show a great improvement upon any previous exhibition building. Also in omitting useless galleries, an annoyance and trouble was obviated.

With regard to that portion of the Industrial Palace which is to be temporary, there is also this consideration to be remembered: temporary and cheap are not synonymous terms when applied to exhibition buildings, for this reason: When designing with such a purpose in view, the first consideration must be to provide proper protection for the articles exhibited, and it must be remembered that some articles require more careful protection than others. A case in point could be easily imagined where one exhibit would require a more costly building to properly protect it for one month, than another would for a whole year. At Vienna this was so fully appreciated, that the temporary parts of the Palace were almost as costly as the permanent portions, the chief difference being made in manner of providing foundations.

If the superstructure of our temporary buildings is made so cheaply as not to afford satisfactory protection against fire and weather, the very

object for which they are intended will be defeated. Exhibitors will not trust their goods where the risk is very great.

The importance of proper railway communications, which shall bring building material and exhibits, and afterwards transfer visitors from the city to the grounds, has already been referred to in our report. The most satisfactory example of the rapid and convenient transfer of people to and from an exhibition building, is undoubtedly to be found at Sydenham, near London. An entirely satisfactory arrangement for the carrying and distribution of freight has yet to be devised.

The experiences at Paris, 1867, and Vienna, 1873, also impress one with the conviction that it seriously affects the gross receipts of an exhibition, not to have the work upon the buildings and grounds completed at the time of the opening ceremonies. Buildings partly full of scaffolding, showing unfinished plastering, unpacked boxes, and lack of arrangement in all directions, make it impossible that the Inauguration should pass off with *éclat*, and the good results from a popular success be assured from the commencement. A poor opening in the presence of so very many of the great from all parts of the world, who are invariably present on such occasions, and invariably expect a creditable display, is not unlike a *faux pas* at the very start.

HENRY PETTIT,

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